

# Sleep Disorders in Adolescents

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## abstract

Chronic sleep deprivation is a common, treatable condition among adolescents. Growing literature supports a myriad consequences that impact overall health, behavior, mood, and academic performance in this vulnerable age group during a time when there are rapid changes in physical development and emotional regulation. This article reviews the epidemiology and health effects of sleep deprivation in adolescents as well as common disorders leading to sleep loss and evidence to support treatment. Although a variety of important sleep disorders may disrupt quality of sleep in adolescents, such as obstructive sleep apnea, restless leg syndrome, and narcolepsy, this article will focus on common disorders that affect the quantity of sleep, such as poor sleep hygiene, circadian rhythm disorders, and insomnia.

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## EPIDEMIOLOGY OF SLEEP DEPRIVATION IN ADOLESCENTS

The average sleep needed for an adolescent to maintain proper health is 8 to 10 hours per night.<sup>1</sup> This recommendation is based on the American Academy of Sleep Medicine expert panel, which reviewed studies on general health, cardiovascular health, metabolism, mental health, and longevity as they relate to sleep duration. The duration applies to total sleep over a 24-hour span and is irrespective of other important aspects of sleep, such as circadian timing and continuity.

Sleep deprivation in adolescents is common. The Youth Risk Behavior Survey found that 72.7% of students reported an average of <8 hours of sleep on school nights.<sup>2</sup> This is similar to the National Sleep Foundation poll, which reported that 62% of students get <8 hours of sleep on week nights. Seniors were the most sleep deprived, with 75% reporting <8 hours of sleep per night<sup>3</sup>; girls and African Americans may be disproportionately affected.<sup>4</sup> Subjective reports of sleep duration are typically less than objective measures, such as actigraphy; therefore, the prevalence of sleep deprivation may be more severe than what is indicated by survey data.<sup>5</sup>

## HEALTH CONSEQUENCES OF SLEEP DEPRIVATION

Lack of sleep is associated with multiple health and academic consequences. First, mood and risk of depression are correlated with sleep duration. Self-reports of poor mood, emotional regulation, and self-harm increase with sleep restriction.<sup>6,7</sup> The relationship between mood and sleep is complex and bidirectional because poor mood and anxiety can worsen insomnia and vice versa.<sup>8</sup> However, data support improvement in depressive symptoms when sleep time is extended.<sup>9</sup>

Metabolism and obesity also correlate with sleep duration, although directionality is unclear.

Observational studies in adults, children, and adolescents show an increase in weight with decreases in sleep time. In a meta-analysis of 12 studies looking at obesity in children, the odds ratio of short sleep duration with obesity was 1.89.<sup>10</sup> Changes in 2 hormones that regulate satiety, leptin, and ghrelin, may play a role.<sup>11,12</sup>

Cognitive performance is impaired with chronic sleep restriction, which can affect academic performance. Attention span, particularly prolonged attention, suffers with sleep deprivation in a dose-dependent manner with no evidence of plateau over a 1-week period.<sup>13</sup> Sleep restriction is associated with declining academic performance from middle school through the collegiate level.<sup>14–16</sup>

We are developing a better understanding of how sleep can affect cardiovascular function, immune regulation, growth, risk-taking, and self-regulation in adolescents. A complete discussion on the health consequences of sleep deprivation are beyond the scope of this article.

## CAUSES OF SLEEP DEPRIVATION IN ADOLESCENTS

Apart from voluntary sleep restriction, there are a variety of sleep issues that can impact the quantity of sleep. This article will discuss poor sleep hygiene, circadian rhythm disorders, and insomnia as well as examine the data to support treatment strategies.

### Poor Sleep Hygiene

Sleep hygiene refers to the behaviors and environmental factors that can affect sleep; these factors are typically modifiable. Some aspects of good sleep hygiene include following a nighttime routine, maintaining a consistent sleep schedule, keeping the sleeping environment cool (68°

F–72°F) and free from noise, and avoiding disruptors of sleep, such as light and screen time.

The recommendation to avoid light and screen time before bed is supported by numerous epidemiological studies that link screen-based activities to sleep disruption. A variety of habits and exposures are associated with worsening sleep metrics, including increased social media use before bed, sleeping with a mobile device, screen use in the late evening, and the number of devices kept in the bedroom.<sup>17–20</sup> A prospective study that implemented a media use plan for families showed benefits in sleep, indicating that the association between media and poor sleep is at least partly causal in nature.<sup>21</sup>

A study looking at body temperature and sleep regulation in adults found that the rate of decrease in body temperature correlates with more sleep time in the early stages of sleep.<sup>22</sup> Similarly, warmer environments are found to impair sleep quality.<sup>23</sup> Caffeine is problematic as early as middle school, with an associated decrease in quality of sleep observed as doses increase.<sup>24</sup>

Poor sleep-hygiene practices appear to be a contributor to sleep disruption in children and adolescents.<sup>25,26</sup> However, there is no consensus as to which elements of sleep hygiene are critical nor which are necessary when implementing sleep-hygiene strategies for insomnia. Similarly, data supporting the role of poor sleep hygiene in causing insomnia, or good sleep hygiene preventing insomnia, are lacking.

### Delayed Sleep-Wake Phase Disorder

Pubertal onset corresponds with a biologically mediated shift in sleep timing with a predisposition to a later sleep-wake cycle. This shift is mediated by 2 distinct processes. First, the homeostatic drive to sleep, which increases with increased wake

time, accumulates slower during adolescence. This translates into a longer time to fall asleep and easier ability to stay awake at night when comparing postpubertal and prepubertal teenagers.<sup>27</sup> Second, melatonin secretion shifts to a later time, causing a delay in the circadian rhythm.<sup>28–32</sup> A delay in circadian physiology predisposes to a mismatch between an adolescent's preferred sleep time and social demands, such as school. Delayed sleep-wake phase disorder (DSPD) is diagnosed when this mismatch causes functional impairment (see Table 1 for diagnostic criteria). An adolescent with DSPD has a normal quantity and quality of sleep when allowed to sleep at will. However, when she or he sleeps at the wrong times on the basis of social demands, DSPD is common. Studies show a prevalence as high as 14% in the adolescent population.<sup>33</sup>

Treatment approaches mainly rely on melatonin supplementation and timing of light exposure. A meta-analysis reviewing the use of melatonin to advance sleep phase in both adolescents and adults found that use of exogenous melatonin advanced endogenous secretion of melatonin by 1.18 hours and decreased average sleep latency by 23 minutes.<sup>34</sup> The time of administration of melatonin appears to be more important than the dose, with ideal timing ~4 to 6 hours before habitual bedtime.<sup>35</sup> The administration of melatonin is recommended in the practice parameters for DSPD by the American Academy of Sleep Medicine.<sup>36</sup>

**TABLE 1** Diagnostic Criteria for DSPD

Significant delay in the major sleep episode compared with wake time and sleep time that is desired or required
Symptoms are present for >3 mo
If allowed to choose sleep schedule, patients show improved sleep quality and duration but maintain a delayed phase in their sleep-wake cycle
Sleep diary or actigraphy for 7–14 d shows delay in time of sleep
Sleep disturbance is not better explained by another cause

Adapted from American Academy of Sleep Medicine. *The International Classification of Sleep Disorders: Diagnostic and Coding Manual*. 2nd ed. Westchester, IL: American Academy of Sleep Medicine; 2005.

**TABLE 2** Treatment of DSPD

Step 1: Avoid bright lights for 30 min before the target bedtime
Step 2: Shift the bedtime earlier; shift by 15–20 min earlier each d
Step 3: Consider use of melatonin; small doses (0.5–1 mg) are effective. Melatonin should be given 4–6 h before the current sleep time
Step 4: Get early morning light; bright lights early in the morning help shift the circadian rhythm to an earlier time point. The one caveat is with extreme delay in the circadian rhythm. If the adolescent routinely wakes up 3 h later on a weekend than they do on weekdays, then bright lights first thing in the morning on a weekday should be avoided. The ideal timing to begin light exposure is 3 h before the time that the adolescent naturally wakes up on a weekend
Step 5: Keep the schedule for bedtime and wake time the same throughout the week

Treatment strategies for DSPD are listed in Table 2.

Light exposure is known to affect circadian timing, but studies evaluating both late light avoidance and using bright light in the morning are limited in adolescents. In a randomized controlled trial of adolescents with DSPD who received early morning light exposure and sleep education, the average sleep latency decreased by 43 minutes and sleep increased by 72 minutes compared with the control group. Given low risk of using bright light therapy in the morning, this is a typical recommendation for adolescents with DSPD.<sup>37</sup>

A growing understanding of age-dependent patterns of circadian physiology are helping shape education policy. An American Academy of Pediatrics policy statement advocates for delayed school start times for middle and high schools.<sup>38</sup> There are increasing data to support this initiative. Delayed start times improve mood, increase overall sleep time, decrease levels of daytime sleepiness, increase school attendance, and reduce car crashes.<sup>39–42</sup> California recently

became the first state to mandate delayed start times for middle and high schools, with the goal being to implement this mandate by July 2022.

Delayed school start times present a variety of logistic and social challenges, including transportation difficulties, decreased interaction between parents and adolescents, and extracurricular scheduling problems. More data are needed to continue to push for this initiative. Data from a 2017 Cochrane Review on this topic suggest several possible benefits, but higher-quality primary studies are needed.<sup>43</sup>

**Insomnia**

Insomnia refers to a decrease in sleep due to difficulty falling asleep, difficulty staying asleep, or awakening too early. Psychophysiological insomnia (PI) is a common subtype of insomnia. It is characterized by the inability to fall asleep or stay asleep due to the intrusion of anxious or stressful thoughts while in bed.<sup>44</sup>

Insomnia is common among adolescents, with rates ranging between 7% and 40% on the basis of the criteria used.<sup>45–47</sup> Those with PI often sleep better in novel environments, such as hotel rooms, which can aid in narrowing the differential. Negative associations with sleep can lead to progressive anxiety with perpetuation of the insomnia. Unfortunately, chronicity of PI is high in adolescents, with up to 88% of those with a history of PI reporting difficulties with ongoing

**TABLE 3** Treatment of Insomnia With CBTi

Stimulus control therapy: If unable to fall asleep after ~20 min, leave the bed until feeling drowsy
Journaling: Make a “worry list” for ~5 min each d after school
Paradoxical intent: Think about quietly staying awake instead of actively trying to go to sleep to decrease anxiety around bedtime
Progressive relaxation: Slow, deep breaths while resting in bed and slowly tensing, then relaxing, individual muscles in the body, starting with the legs and moving upward
Sleep restriction: Artificially limiting the sleep opportunity to less than what the adolescent naturally needs; once sleeping more consistently, the sleep opportunity is increased

insomnia.<sup>47</sup> Asking about intrusive thoughts and anxiety in bed is vital to distinguish PI from DSPD. Both sleep disorders can also coexist.

Cognitive behavioral therapy for insomnia (CBTi) is an effective treatment of PI in adults that is based on more than a decade of research into both short-term and long-term improvement.<sup>48,49</sup> CBTi is shown to be more effective than conventional sleep aids in the long-term for adults.<sup>50,51</sup> Table 3 includes the common components of CBTi. Data for CBTi in adolescents are not as robust, but studies do indicate benefit for this population. A randomized controlled trial with Internet-based individual therapy and group therapy used 6 weekly sessions in which participants received counseling on sleep hygiene, sleep restriction, stimulus control, psychoeducation, and relaxation techniques. The study tracked both subjective report of sleep symptoms as well as objective sleep measures using actigraphy. Those receiving CBTi showed improvements in sleep onset latency, sleep efficiency, total sleep time, and waking after sleep onset in both CBTi groups compared with the control group. Similarly, subjective reports of insomnia and symptoms of sleep deprivation improved in both groups.<sup>52</sup> A 1-year follow-up study showed persistent benefit or improvement in sleep efficiency and quality-of-life scores in both treatment groups.<sup>53,54</sup> Less rigorous studies also indicate benefit of CBTi for sleep parameters in adolescents.<sup>55–57</sup> However, more

studies looking at long-term benefits, ideal method of delivery, and comparison of CBTi to pharmacologic therapy are needed.

### FUTURE DIRECTIONS

Over the past 4 decades, sleep scientists have developed an understanding of the mechanisms that regulate sleep, the normative values of sleep, as well as the health consequences of sleep deprivation. However, over these same 4 decades, the incidence of sleep deprivation appears to be increasing.<sup>58</sup> With growing literature to support the role of good sleep health and efficacy of treatments, there is an increased need to proactively screen adolescents for common sleep disorders. Awareness about sleep is increasing, partly because of wearable technologies and trackers. With this awareness and accessibility must come strategies to harness data and effectively deliver evidence-based care. Healthcare providers should continue to advocate for changes at both the individual level and community level, such as with delayed school start times. Further research is required to understand which strategies best promote optimal sleep health for adolescents to guide future initiatives.

### ABBREVIATIONS

CBTi: cognitive behavioral therapy for insomnia  
DSPD: delayed sleep-wake phase disorder  
PI: psychophysiological insomnia

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